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Does facial sebum excretion really affect the development of acne?

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None declared.

Summary

Background It is generally accepted that the severity of acne is correlated with facial sebum secretion. However, previous studies on the relation between seborrhoea and the development of acne did not consider topographical differences in facial sebum secretion and used relatively vague acne severity grading systems.

Objectives To elucidate the relation between topographical variations in facial sebum secretion and the severity of acne in women.

Methods Forty-six female controls and 46 women with acne were included in this study. The Sebumeter® was used to measure facial sebum secretion in the following facial areas: forehead, nose, chin, and right and left cheek. We counted non-inflammatory comedones and inflammatory acne lesions in the same areas. We compared sebum secretion between patients with acne and controls, and analysed the relation between the quantity of sebum secreted and the number of acne lesions.

Results Sebum secretions in the whole face and in the T- and U-zones (areas of high and low sebum secretion, respectively) were higher in patients with acne than in controls. There was no correlation between sebum quantity and acne lesion count in most facial regions.

Conclusions Increased levels of facial sebum secretion were observed in patients with acne. Our findings indicate that increased sebum levels do not directly cause development of acne lesions.

Acne is a disease of the pilosebaceous unit. The major pathogenic factors promoting acne are increased sebum production caused by androgen action, ductal hypercornification, colonization by *Propionibacterium acnes*, and inflammation.[1,2] Increased sebum production stimulated by androgens is nearly always the first listed pathogenic factor promoting acne. However, facial sebum secretion depends upon the topography of the face. For example, it is generally accepted that the T-zone is greasier than the U-zone.[3] The relationship between seborrhoea and development of acne has been discussed in previous studies.[4–10] However, in most studies the methods used for measuring sebum secretion were inconvenient and were not standardized, and topographical differences of sebum secretion in facial skin were not considered. To demonstrate a relationship between sebum secretion and the development of acne lesions, measurements should be made at different facial sites. Various grading systems have been used to assess acne severity, but there is no generally accepted quantitative system in use.[11] Lesion counts may be acceptable for representing acne severity, but the method is laborious, inaccurate and irreproducible.

In this study, we measured sebum secretion at five facial sites and counted acne lesions at these sites using a lesion counting method that we developed, to elucidate the relationship between facial sebum secretion and acne lesion development in women with acne with a view to determining whether increased facial sebum secretion causes acne lesions directly.

Materials and methods

Subjects

All controls and patients with acne were women in their third and fourth decades. The patients with acne were selected by one investigator. The inclusion criteria were: patients who had not taken isotretinoin or any other medication known to affect sebum secretion, and who had not received chemical peeling or any surgical treatment for acne within 6 months of study commencement. Patients unaware of their medication type were excluded. Regarding the normal controls, as it was difficult to find individuals who have never experienced acne, we

included control subjects who reported never having had more than five acne lesions simultaneously at any time, and who had no visible acne lesions at the time measurements were taken.

Measurement of sebum secretion

Facial sebum secretions were measured using a Sebumeter® (SM815; C-K Electronics, Cologne, Germany). Five different facial sites were selected: forehead (mid-glabella), nose (the tip), right and left cheeks (the most prominent area of both zygomata), and chin (mental prominence). Sebum was collected from each site on a plastic strip using a constant pressure of 10 N for 30 s. Participants were asked not to use any cosmetics and not to wash within 2 h of measurements. Amounts of sebum secretion were recorded and mean facial sebum excretion (MFSE)[1] was calculated. Measurement areas were classified as follows: high sebum secreting zone (T-zone; forehead, nose and chin) and low sebum secreting zone (U-zone; both cheeks). All procedures were performed by the same investigator in a room at constant temperature (22 °C) and relative humidity (42%). Measurements were started in the summer of 2003, and repeated on the same volunteers at 3-monthly intervals. The patient facial skin types were determined using the sebum secretion guidelines supplied with the Sebumeter®. However, because these guidelines list reference values for individual measurement sites only, they could not be used directly for determining the skin types of the T-zone, the U-zone or the whole face (MFSE). Thus, we obtained new sebum secretion reference values for these areas by calculating the mean value for each location. The reference values used to evaluate the facial skin types are listed in Table 1.

Clinical digital photographs and lesion counting

Three clinical photographs were taken of the patients with acne: *en face*, and right and left lateral profiles. All photographs were taken using a digital camera (DSC-F717; Sony, Tokyo, Japan). We divided the surface of the face into forehead, right cheek, left cheek, nose and chin areas. The boundaries of these areas were determined based on regional variations in sebum secretion (Fig. 1). Acne lesions were classified as noninflammatory (noninflammatory comedonal papules) or inflammatory lesions (including inflammatory papules, pustules, nodules and cysts). Forehead, nose and chin acne lesions were counted using *en face* photographs. Right cheek and left cheek lesions were counted using the right and left lateral profile photographs, respectively. Digital photograph images were manipulated using digital retouching software: Jasc Paint Shop Pro 8.0 (Jasc, Eden Prairie, MN, U.S.A.). Noninflammatory lesions were marked with a gold circle and inflammatory lesions with an orange circle on photographs using the picture tube tool in Paint Shop Pro 8.0, and the numbers of each circle type were counted, not the lesions themselves, to avoid duplicated counting. An example for our acne lesion counting method using digital photography is shown in Figure 2. This work was done by agreement between three dermatologists, to minimize individual error with respect to lesion classification.

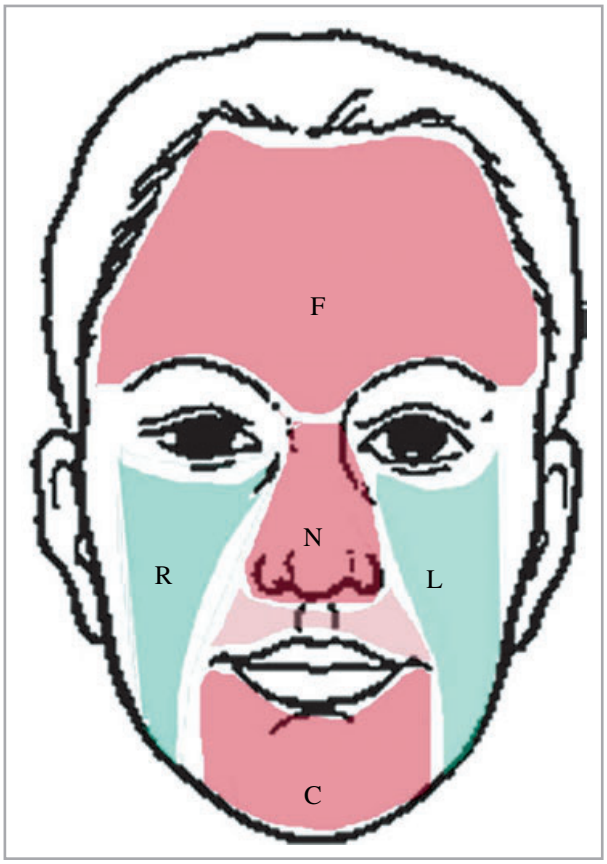

Fig 1. Areas of each facial region to be evaluated by lesion counts. F, forehead; N, nose; C, chin; R, right cheek; L, left cheek. Lesions on the upper lip area and lesions located outside the shaded areas were not counted.

Table 1 Reference values for the evaluation of facial skin type by sebum secretion measured with the Sebumeter® (μg cm^{-2})

Skin type	Whole face (MFSE)	T-zone	U-zone
Dry	< 88	< 100	< 70
Normal	88–204	100–220	70–180
Oily	> 204	> 220	> 180

MFSE, mean facial sebum excretion. The reference values were calculated by the following equations using regional reference values for sebum secretion suggested by the manufacturers: whole face = [sum of reference values for the forehead, nose, chin and both cheeks]/5; T-zone = [sum of reference values for the forehead, nose and chin]/3; U-zone = [sum of reference values for both cheeks]/2.

Statistical analysis

Comparisons between patients and controls with respect to amounts of sebum secreted were evaluated using Student's *t*-test. The Wilcoxon rank sum test was used to compare

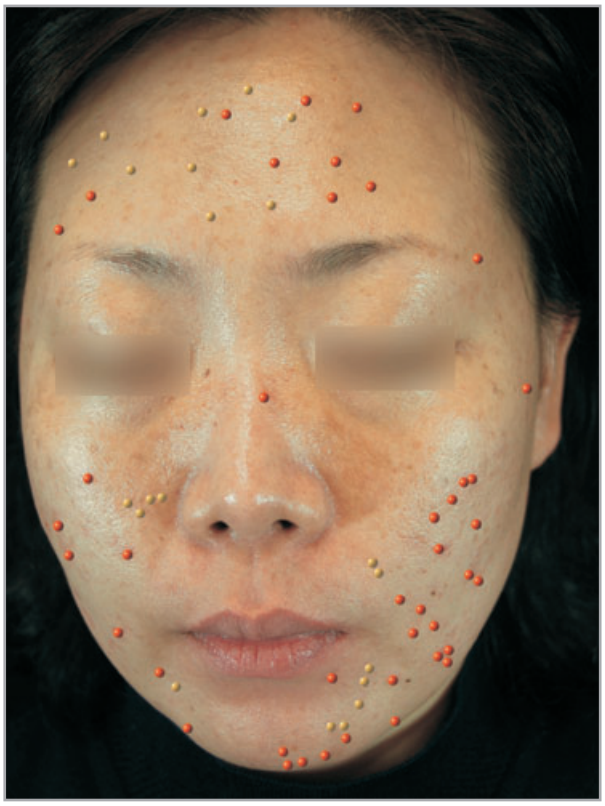

Fig 2. An example of the lesion counting method using digital photography. Gold circles, noninflammatory lesions; orange circles, inflammatory lesions.

subjects with dry skin types because sample sizes were insufficient for the Student's t-test. Comparisons of lesion counts for dry and normal skin types were done using Student's t-test. The strength of the association between sebum secretion and lesion number was evaluated using Pearson's correlation coefficients. $P < 0{\cdot}05$ was considered to be statistically significant.

Results

Demographics

Forty-six patients and 46 controls were enrolled in the study. All were women. The mean age of the control group was 27·0 years and that of the acne patient group was 27·3 years, which was not statistically different ($P > 0{\cdot}05$).

Sebum secretion was elevated in the acne group

The MFSE ± SD of controls and patients with acne was 89·71 ± 36·77 μg cm^{-2} and 132·72 ± 41·74 μg cm^{-2}, respectively. Sebum excretion in the T- and U-zones of controls and patients with acne was as follows: T-zone: 116·45 ± 41·65 μg cm^{-2} and 158·82 ± 44·53 μg cm^{-2}, U-zone: 49·60 ± 36·47 μg cm^{-2} and 93·57 ± 51·62 μg cm^{-2} (Fig. 3). Thus, statistically significant differences were found between the control and patient groups in every facial zone

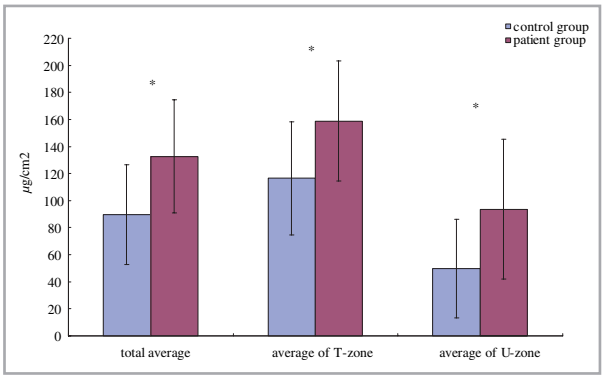

Fig 3. Comparison of mean ± SD facial sebum secretion between controls and patients with acne. *$P < 0{\cdot}01$.

($P < 0{\cdot}01$). The T-zone showed significantly higher sebum secretion than the U-zone in both groups ($P < 0{\cdot}01$). Skin type classification in terms of MFSE for controls and patients with acne was as follows: a normal skin type was found in most patients with acne (80%), and a dry skin type in most controls (61%) (Table 2). Contrary to expectations, most patients with acne had normal skin type rather than oily skin type, which may be because the guidelines of the Sebumeter® manufacturer were not optimized for Korean women. In patients with acne, the skin type of the T-zone was nearly the same as that of the whole face, whereas in the normal controls the normal skin type exceeded the dry skin type (Table 3). The dry skin type was higher in the U-zone in both groups: 33% in the patient group and 76% in the control group (Table 4). For the dry skin type, there were no statistically significant

Table 2 Classification of facial skin type according to mean facial sebum excretion

	Dry	Normal	Oily	Total
Controls	28 (61%)	17 (37%)	1 (2%)	46 (100%)
Patients	7 (15%)	37 (80%)	2 (5%)	46 (100%)

Table 3 Classification of skin type according to the sebum secretion of T-zone

	Dry	Normal	Oily	Total
Controls	15 (33%)	30 (65%)	1 (2%)	46 (100%)
Patients	6 (13%)	37 (80%)	3 (7%)	46 (100%)

Table 4 Classification of skin type according to the sebum secretion of U-zone

	Dry	Normal	Oily	Total
Controls	35 (76%)	11 (24%)	0 (0%)	46 (100%)
Patients	15 (33%)	28 (70%)	3 (7%)	46 (100%)

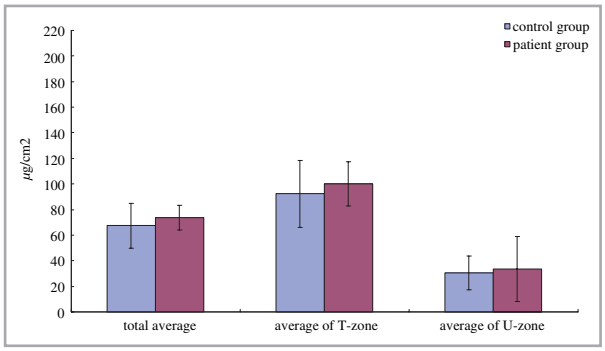

Fig 4. Comparison of mean ± SD facial sebum secretion for dry skin type. There was no statistically significant difference between patient and control groups.

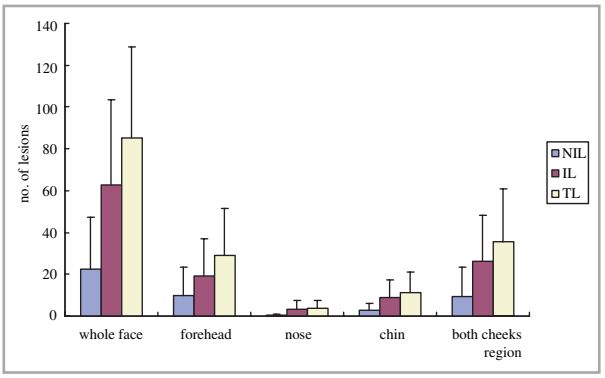

Fig 6. Mean ± SD numbers of different types of acne lesions in different facial regions. NIL, noninflammatory lesions; IL, inflammatory lesions; TL, total lesions.

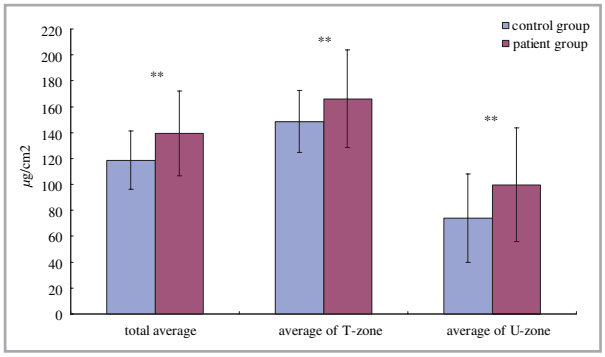

Fig 5. Comparison of mean ± SD facial sebum secretion for normal skin type. **P < 0·05.

Table 5 Mean ± SD numbers of acne lesions according to skin type

	Mean number of acne lesions		
Skin type	Noninflammatory lesions	Inflammatory lesions	Total lesions
Dry	29·0 ± 39·45	40·43 ± 16·93	69·43 ± 45·50
Normal	20·95 ± 22·13	63·0 ± 40·04	83·95 ± 39·02
P-value	0·445	0·023*	0·384
Oily	29·0	134·0	163·0

*Statistically significant difference in the lesion counts between dry and normal skin type (Student's t-test). (There were too few lesion counts in the oily skin type group to perform a statistical comparison). Oily group had not enough subjects to perform a statistical comparison.

differences between the acne and control groups in any facial region (Fig. 4). However, for the normal skin type, the patient group showed more sebum secretion than the control group in all facial regions (Fig. 5). Statistical analysis was not done on the oily skin type because of the small sample sizes involved.

Correlations between facial sebum secretion and acne lesion counts

The mean numbers of different types of acne lesions in different facial regions are shown in Figure 6 for the patient group. The mean ± SD numbers of total acne lesions, inflammatory lesions and noninflammatory papules were 85·17 ± 43·65, 62·65 ± 40·79 and 22·52 ± 24·98, respectively. By facial skin type, the mean ± SD numbers of noninflammatory lesions were 29·0 ± 39·45 for the dry skin type, 20·95 ± 22·13 for the normal type, and 29·0 for the oily type (Table 5), and the mean ± SD numbers of inflammatory lesions were 40·43 ± 16·93 for the dry skin type, 63·0 ± 40·04 for the normal type, and 134·0 for the oily type. A statistically significant difference was found between the mean numbers of inflammatory lesions between dry and normal skin types in the patient group (Table 5). However, in terms of total acne lesions, no significant difference was found between dry and normal skin type.

A correlation analysis using logistic regression was performed to establish the relation between regional facial sebum secretion and number of acne lesions by type (Table 6). Significant relations were found between sebum secretion and noninflammatory lesions of the chin (γ = 0·491, P < 0·01), inflammatory lesions of the U-zone (γ = 0·364, P < 0·05) and total acne lesions of the U-zone (γ = 0·335, P < 0·05). However, in most facial regions the numbers of acne lesions, regardless of type, were not found to be significantly associated with sebum secretion (Table 6).

Discussion

A correlation between the severity of acne and facial sebum secretion is generally accepted,[4–10] but previous studies have failed to consider topographical variations in facial sebum secretion. Facial areas can be categorized as T- and U-zones (high and low sebum secreting areas, respectively) on the basis of sebum secretion levels.[3,12] Moreover, the distribution

Table 6 Correlations between facial sebum excretion and acne lesion counts

		MFSE	T-zone	Forehead	Nose	Chin	U-zone
Noninflammatory lesions	γ	−0·059	−0·109	−0·255	0·194	0·491	0·042
	P-value	0·696	0·471	0·087	0·195	0·001*	0·781
Inflammatory lesions	γ	0·271	0·107	0·066	−0·099	0·112	0·364
	P-value	0·068	0·478	0·664	0·521	0·475	0·013*
Total lesions	γ	0·220	0·043	−0·099	−0·070	0·281	0·335
	P-value	0·143	0·777	0·511	0·654	0·068	0·023*

MFSE, mean facial sebum excretion; γ, Pearson's correlation coefficient. *$P < 0·05$.

patterns of acne lesions are heterogeneous on an individual basis. Some patients may have acne lesions in an oily area, whereas others may have lesions in a dry area, and even patients with dry facial skin present with severe acne. However, previous studies on the correlation between sebum secretion levels and the severity of acne have measured the amount of facial sebum only on the forehead, a representative oily area of the face. Thus the data collected cannot reflect local variations in sebum secretion and their effects on acne development. Another shortcoming of these earlier studies is that the methods used for acne severity evaluation were crude. In fact, no single acne grading system is generally accepted, and several systems are used on a preferential basis. A global three-grade acne classification system (i.e. mild, moderate and severe) has been used in previous studies,[6] as has the Leeds technique.[4] However, these assessment systems depend wholly on a rater's impressions, and do little to circumvent issues of internal validity and reproducibility. The Leeds technique is limited by its complexity and because it can only be used on *en face* photographs, and thus it gives little weighting to lesions of the cheeks and chin. Acne lesion counting is another method used for acne severity evaluations, but it has high inter- and intrarater variability, and there is a risk of duplicate lesion counting.[11]

In this study, we measured sebum secretion at five locations on the face to consider regional variations in sebum secretion. In addition, our study incorporates an acne grading system which increases the evaluation accuracy. However, our study has its limitations. The Sebumeter® was used as a measuring tool, and its measurement area is limited to skin contacting the unit's cassette probe. However, the areas in which lesions were counted were larger than this sebum measuring area, and thus there is a possibility of a disparity between the lesion count area and the sebum measuring area.

The absence of correlation between sebum secretion and lesion counts in most facial regions suggests that secreted facial sebum cannot be the only factor inciting the development of acne lesions. Increased sebum secretion is a major component in the pathogenesis of acne, but increased sebum secretion simply increases the likelihood of developing acne lesions, and does not constitute a direct and unique cause of lesion development. For example, the scalp secretes high levels of sebum, but comedogenesis is rarely observed even in patients with severe acne.[13] The present study shows that noninflammatory comedones on the chin, and inflammatory and total lesions in the U-zone, were significantly associated with local sebum secretion. However, their correlation coefficients did not show strong associations, which implies that other factors play an important role in the development of acne in these regions. Increased sebum secretion with follicular obstruction in the same follicle could incite comedogenesis, but increased sebum secretion without follicular obstruction cannot create comedones. Thus, repeated facial washing to remove seborrhoea from the skin surface would not be expected to improve clinical acne. A recent study with orally administered type I 5α-reductase inhibitor, which suppresses facial sebum secretion, showed that the suppression of facial sebum production does not improve acne lesions.[14] This study supports our results.

One more point is worth considering. We performed this study in women, and sebum secretion patterns differ in men and women. Thus there may be a different association between sebum secretion and acne lesion development in men. A further study including males should therefore be performed.

In conclusion, increased facial sebum secretion in women with acne was not found to be the primary cause of acne lesion development, or even of the formation of noninflammatory comedones or inflammatory acne lesions. Rather it is just an epiphenomenon or an aggravating condition in patients with acne. A future study on local androgen receptor variations in follicle openings, which may lead to follicular obstruction, may clarify the association between variations in regional sebum section and acne development.

Acknowledgments

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